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DEPARTMENT OF SCIENCES, III SEMESTER M.Sc. (Physics) END SEMESTER EXAMINATIONS, NOVEMBER 2019

ATOMIC AND MOLECULAR PHYSICS [PHY 5101]

(REVISED CREDIT SYSTEM - 2017)

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Note: (i) Answer ALL questions

(ii) Draw diagrams and write equations wherever necessary

- 1. (a) Explain the theory of Normal Zeeman Effect.
 - (b) How does Natural broadening contribute to the line width of spectra?
 - (c) What is meant by fine structural of spectral lines. [5+3+2]
- 2. (a) What are Einstein's coefficients with reference to the laser? Derive the relation between them.
 - (b) What is chemical shift during resonance absorption. Explain with an example.
 - (c) ¹³C shows NMR spectrum, however ¹²C does not show NMR spectrum. Why?

[5+3+2]

- 3. (a) What is centrifugal distortion? Explain the effect of centrifugal distortion on the moment of inertia and energy of a diatomic molecule.
 - (b) Homonuclear diatomic molecules do not show vibrational spectra. Why?

(c) The fundamental and first overtone transitions of CO are centred at 2143.3cm⁻¹ and 4260.0 cm⁻¹. Calculate the equilibrium oscillation frequency, the anharmonicity constant and force constant of the molecule. The reduced mass of CO molecule is 1.1385×10^{-26} kg. [3+2+5]

- 4. (a) Explain quantum theory of Raman scattering.
 - (b) How do you correlate Raman and IR active vibrations in a molecule.

(c) The fundamental band for HCl is centered at 2886 cm⁻¹. Assume that the internuclear distance is 1.276×10^{-10} m, calculate the wave number of the first two lines of each of the P and R branches of HCl. [3+2+5]

- 5. (a) What is the basic principle of photoelectron spectroscopy (PES)?
 - (b) List the necessary conditions required to get Mossbauer spectra?

(c) The values of equilibrium oscillation frequency and anharmonicity constant for lower and upper states of CO are 2170.21 cm⁻¹, 0.0062 and 1515.61 cm⁻¹, 0.0114 respectively. The (0,0) transitions is observed at 64746.55 cm⁻¹. Calculate the energy difference of the two electronic states. [3+2+5]